

THE DISTRIBUTION AND HOST RANGE OF *ENTOMOPHAGA GRYLLI*
(FRESENIUS), A FUNGAL PARASITE OF
GRASSHOPPERS IN SOUTH DAKOTA

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Abstract.—The effect of *Entomophaga grylli* on grasshopper populations within South Dakota was investigated during a 2-year period. Field observations established that the state's 3 most important species of grasshoppers are susceptible to pathotype 2 infections. Outbreaks are believed to be initiated annually from the soil of undisturbed areas which act as the reservoir for *Entomophaga grylli* resting spores. The occurrence of the fungus in regions of the state receiving 355 mm of rain during the growing season indicate pathotype 2 infection is maintained in dry environments.

Entomophaga grylli (Fresenius) was first described by Fresenius (1856) attacking a species of *Gryllus* near Frankfurt, Germany. *E. grylli* is best known as a pathogen of grasshoppers and locusts. The fungus is commonly found attacking insects throughout the world (MacLeod, 1956). *E. grylli* has frequently been observed attacking susceptible species of grasshoppers across the United States (Hutchison, 1963).

In South Dakota, Severin and Gilbertson (1917) stated that at least two species of grasshoppers were found to be killed by a fungus. Although these species were not identified in their report, Riker mounts made by Severin include cadavers of *Melanoplus bivattatus* (Say) containing resting spores of *E. grylli*.

E. grylli plays a significant role in the natural control of grasshoppers and is the most important fungal pathogen of grasshoppers (Dempster, 1963). Both cropland and rangeland species of grasshoppers are susceptible to infection by *E. grylli* (Hayes and DeCoursey, 1938; Hewitt, 1979; MacLeod and Muller-Kogler, 1973; Pickford and Riegert, 1964; Rockwood, 1950).

Grasshoppers succumbing to infection by *E. grylli* behave in a characteristic manner. Disease symptoms normally do not appear until the fungus is in its advanced stages. Prior to death there may be a general restlessness, cessation of feeding, and loss of coordination (Madelin, 1963). Infected individuals tend to climb upwards on vegetation and die with their legs wrapped around the plant (Fig. 1).

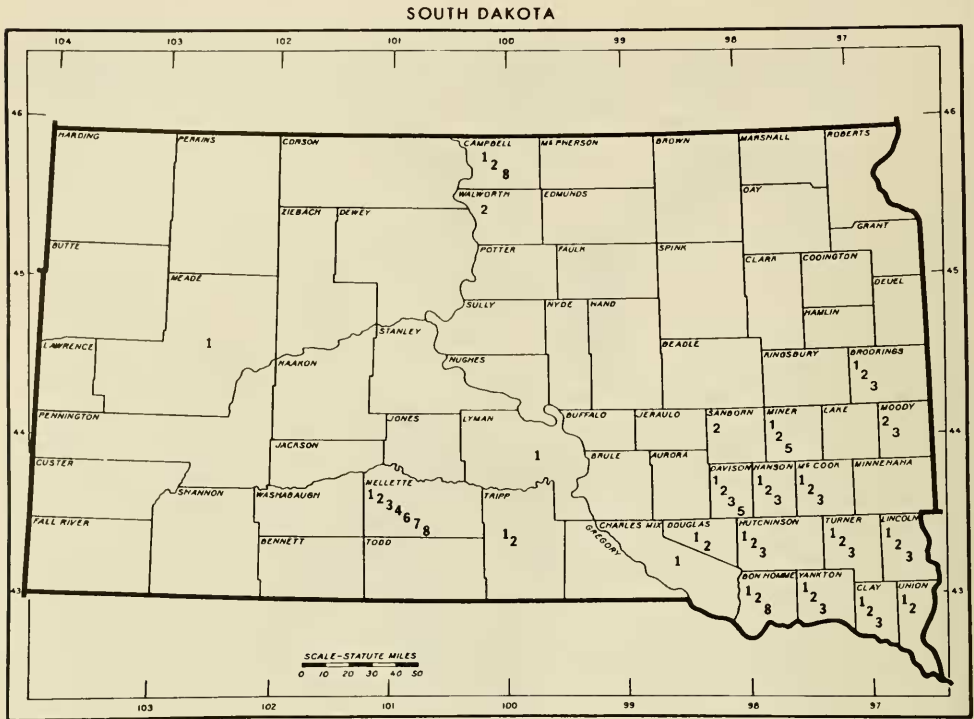
Following death there may be a distention of the abdomen in which the membrane separating the abdominal sclerites breaks and the fluid containing the fungus flows down the plant, collecting on the stem and leaves. The whole abdomen may tear loose from the thorax and drop to the ground during this soft stage of the grasshopper cadavers. In specimens where distention does not occur, the abdomen



Fig. 1. Fungus-killed grasshoppers clinging to vegetation.

often curls upward and forwards, in some cases touches the pronotum (Schaefer, 1936). In material observed in South Dakota, this curling was most often found to be associated with nymphal stages. In most specimens killed by the fungus the body becomes very hard and is filled with resting spores.

In South Dakota the average grasshopper hatch will begin by mid-May in the



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Fig. 2. Observed occurrence of *E. grylli* in grasshoppers, 1980–81. 1, *M. bivittatus*. 2, *M. differentialis*. 3, *M. femurrubrum*. 4, *M. sanguinipes*. 5, *M. packardii*. 6, *M. confusus*. 7, *M. lakinus*. 8, *P. nebrascensis*.

western and southern regions. There may be a variance in the hatching date of approximately one month between different regions of the state. Among the state's three most important species, *Melanoplus bivittatus* (Say), *Melanoplus differentialis* (Thomas), *Melanoplus femurrubrum* (DeGeer), there may be a three week difference in hatching dates. Of these, *M. bivittatus* is the early hatching species and may appear 2–3 weeks prior to the first emergence of either *M. differentialis* or *M. femurrubrum*.

In 1980–81 surveys were conducted to determine the natural distribution and host specificity of *E. grylli* in grasshopper populations within South Dakota. The map in Figure 2 shows the counties in which natural outbreaks of *E. grylli* occurred. A total of eight species of grasshoppers were found to be infected (see map for locations): *M. bivittatus* (Say), two-striped grasshopper; *M. differentialis* (Thomas), differential grasshopper; *M. femurrubrum* (DeGeer), red-legged grasshopper; *M. sanguinipes* (Fabricius), migratory grasshopper; *M. packardii* Scudder, Packard grasshopper; *M. confusus* (Scudder), little pasture spur-throated grasshopper; *M. lakinus* (Scudder), lakinus grasshopper; *Phoetaliotes nebrascensis* (Thomas), large-headed locust.

The first outbreak was observed in Mellette County July 3, 1980 at White River, S.D. The largest outbreak in the southeastern section of South Dakota in 1981

was in Davison County at Mitchell, S.D. This outbreak was first discovered in August 25, 1981. A survey of the southeastern section of the state during the month of August, 1981 indicated that small outbreaks were widespread. The majority of grasshoppers dying from the fungus were found in areas not subject to cultivation (field borders, roadside ditches, alfalfa fields). However, diseased grasshoppers were collected from the edges of cornfields (Brookings County) and soybean fields (Davison County). The outbreak in the northcentral portion of the state was in Campbell County and occurred on the South Dakota–North Dakota state line in wheat fields in late August.

Different strains of *E. grylli* have been found to be lethal to different grasshopper species according to Pickford and Riegert (1964). Soper et al. (In preparation) reported the existence of different pathotypes for *E. grylli*. Pathotype 1, which is characterized by producing both the conidial and resting spore states in contrast to pathotype 2, which lacks the conidial cycle.

Field observations suggest that only pathotype 2 infections occur within the state. Grasshopper species within South Dakota that are known to be susceptible to pathotype 1 infections, were not found to be cross infected by the pathotype 2 form of *E. grylli*. This supports the findings of others (Pickford and Riegert, 1964; Milner, 1978; Soper et al. (In preparation)) that different strains of the fungus are lethal to different species of grasshoppers. Nevertheless, from this investigation it is evident that in South Dakota all species of grasshoppers that are of immediate importance and those that have the potential to be destructive in the future are susceptible to either pathotype 1 or pathotype 2 infections of *E. grylli*.

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